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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/737,205	12/15/2003	Trishul Chilimbi	3382-66145	7671
26119 7590 07/27/2007 KLARQUIST SPARKMAN LLP 121 S.W. SALMON STREET SUITE 1600 PORTLAND, OR 97204			EXAMINER FRANCIS, MARK P	
			ART UNIT 2193	PAPER NUMBER
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/737,205

Applicant(s)

CHILIMBI ET AL.

Examiner

Mark P. Francis

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 11 May 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-52 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-52 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

1. This action is responsive to the communication filed on May 11, 2007.
2. Claims 1-52 are pending.

Response to Amendment

3. The 35 U.S.C. 101 rejection of claims 1,17,and 29 has been withdrawn in view of Applicants' amendment.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. Claims 44-52 rejected under 35 U.S.C. 102(e) as being anticipated by Breslau (U.S. PUB 2002/0133639).

With respect to claim 44, Breslau discloses a system for coallocating data in memory to improve cache performance, (Col 1:0013, "...managing the object at runtime...", Col 3:0032, "...to increase the processing capacity...") the system comprising:

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an analysis module for determining a coallocation solution based at least in part upon a temporal data access profile of a computer program; (Col 1:0015, "...preserving the state of the object during the migrating...")

an instrumentation module for automating alteration of the computer program based at least in part upon the coallocation solution; (Col 4:0041-0044, "...removal of the object from memory...")

and an enforcement module for automatically enforcing the coallocation solution during execution of the altered computer program. (Col 3:0036-0038, "...and accordingly generates a "split" request therefor...")

With respect to claim 45, the rejection of claim 44 is incorporated and further Breslau discloses further comprising: a profiling module for generating the temporal data access profile. (Col 3:0036, "...a performance monitor may detect...")

With respect to claim 46, the rejection of claim 44 is incorporated and further Breslau discloses that the instrumentation module comprises a binary re-writer. (Col 4:0041-0044, "...removal of the object from memory...")

With respect to claim 47, the rejection of claim 44 is incorporated and further Breslau discloses that the instrumentation module automates changing of heap allocation requests to heap coallocation requests. (Col 5:0053-0055, "...When the ORB receives an invocation request for an object...")

With respect to claim 48, the rejection of claim 44 is incorporated and further Breslau discloses that the enforcement module comprises a library for run time support of heap coallocation requests. (Col 5:0053, "...within the Split Routing Table...")

With respect to claim 49, the rejection of claim 44 is incorporated and further Breslau discloses further comprising a plurality of memory arenas in which to implement the coallocation solution. (Col 5:0053-0056, "...the list of instances within the Split Routing Table...")

With respect to claim 50, the rejection of claim 44 is incorporated and further Breslau discloses that the analysis module determines a heat value for each of one or more hot data streams in the temporal data access profile. (Col 5:0053-0055, "...The heuristic used to make such a decision...")

With respect to claim 51, the rejection of claim 44 is incorporated and further Breslau discloses that the temporal data access profile traces object field accesses. (Col 4:0041-0044, "...Regarding object accesses...")

With respect to claim 52, the rejection of claim 44 is incorporated and further Breslau discloses that the temporal data access profile traces object accesses. (Col 4:0041

0044, "...Regarding object accesses...")

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claims 1-43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Breslau. (U.S. Pub 2002/0133539) in view of Wolczko. (U.S. PGPUB 2004/0133556)

With respect to claim 1, Breslau discloses a computer-implemented method of enhancing cache performance, (Col 1:0013, "...managing the object at runtime...", Col 3:0032, "...to increase the processing capacity...") the method comprising: receiving a temporal data reference profile; (Col 1:0015, "...preserving the state of the object during the migrating...") detecting one or more hot data streams in the temporal data reference profile; (Col 3:0036, "...a performance monitor may detect...") and analyzing the one or more hot data streams and the temporal data reference profile to determine a coallocation solution for allocations in heap memory. (Col 3:0032-0035, "...the single instance, object B is split...", Col 5:0053-0055, "...an object that has a split status...")

but does not disclose and enforcing the coallocation solution during subsequent execution of the computer program by coallocating sets of heap objects in heap memory arenas in order to improve locality for accesses of the heap objects.

Wolczko discloses and enforcing the coallocation solution during subsequent execution of the computer program by coallocating sets of heap objects in heap memory arenas(Col 1:0012-0017, "...determines the skew value for the object during class definition time...") in order to improve locality for accesses of the heap objects in an analogous system for the purpose of facilitating skewing a bi-directional object layout to provide good cache behavior.(Wolczko: Col 1:0012)

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to coallocate sets of heap objects in heap memory arenas to improve locality accesses of heap objects to Breslau's invention using the teachings of Wolczko.

The modification would have been obvious because one of ordinary skill in the art would have been motivated to facilitate skewing a bi-directional object layout to provide good cache behavior.(Wolczko: Col 1:0012)

With respect to claim 17, Breslau discloses a computer-readable medium(e.g. See Fig. 1 elements 15 and 19 and related text) storing computer-executable instructions for causing a computer system programmed thereby to perform a method of enhancing

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cache performance, (Col 1:0013, "...managing the object at runtime...", Col 3:0032, "...to increase the processing capacity...") the method comprising: receiving a profile of object field accesses; (Col 1:0015, "...preserving the state of the object during the migrating...")

and determining a coallocation solution based at least in part upon the profile, (Col 0032, "...is split...") wherein the coallocation solution increases locality of object fields (Col 5:0051-0054, "...the object identifier...is associated with a SIP corresponding to a Split Routing Table...") in a layout in memory to improve cache performance. (Col 3:0032-0035, "...the single instance, object B is split...", Col 5:0053-0055, "...an object that has a split status...") but does not disclose and enforcing the coallocation solution during subsequent execution of the computer program by coallocating sets of heap objects in heap memory arenas in order to improve locality for accesses of the heap objects.

Wolczko discloses and enforcing the coallocation solution during subsequent execution of the computer program by coallocating sets of heap objects in heap memory arenas (Col 1:0012-0017, "...determines the skew value for the object during class definition time...") in order to improve locality for accesses of the heap objects in an analogous system for the purpose of facilitating skewing a bi-directional object layout to provide good cache behavior. (Wolczko: Col 1:0012)

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Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to coallocate sets of heap objects in heap memory arenas to improve locality accesses of heap objects to Breslau's invention using the teachings of Wolczko.

The modification would have been obvious because one of ordinary skill in the art would have been motivated to facilitate skewing a bi-directional object layout to provide good cache behavior.(Wolczko: Col 1:0012)

With respect to claim 29, Breslau discloses a computer-readable medium storing computer-executable instructions for causing a computer system (Col 2:0028, "...a single execution environment computer system...") programmed thereby to perform a method of enhancing cache performance, (Col 1:0013, "...managing the object at runtime...", Col 3:0032, "...to increase the processing capacity...") the method comprising:

receiving a comprehensive temporal data access profile for a computer program; (Col 1:0015, "...preserving the state of the object during the migrating...")

detecting one or more data access patterns in the temporal data access profile, each of the one or more data access patterns including plural data accesses and occurring one or more times in the temporal data access profile; (Col 3:0036, "...a performance monitor may detect...")

and analyzing the one or more data access patterns and the temporal data access profile to determine a coallocation solution for allocations in memory. (Col 3:0032-0035, "...the single instance, object B is split...", Col 5:0053-0055, "...an object that has a split status...") but does not disclose and enforcing the coallocation solution during subsequent execution of the computer program by coallocating sets of heap objects in heap memory arenas in order to improve locality for accesses of the heap objects.

Wolczko discloses and enforcing the coallocation solution during subsequent execution of the computer program by coallocating sets of heap objects in heap memory arenas (Col 1:0012-0017, "...determines the skew value for the object during class definition time...") in order to improve locality for accesses of the heap objects in an analogous system for the purpose of facilitating skewing a bi-directional object layout to provide good cache behavior. (Wolczko: Col 1:0012)

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to coallocate sets of heap objects in heap memory arenas to improve locality accesses of heap objects to Breslau's invention using the teachings of Wolczko.

The modification would have been obvious because one of ordinary skill in the art would have been motivated to facilitate skewing a bi-directional object layout to provide good cache behavior. (Wolczko: Col 1:0012)

With respect to claims 2 and 30, the rejections of claims 1 and 29 are incorporated respectively and further Breslau discloses that the temporal data access profile traces accesses of objects, and wherein the one or more data access patterns are for object accesses. (Col 4:0041-0044, "...Regarding object accesses...")

With respect to claims 3,18 and 31, the rejections of claims 1,17 and 29 are incorporated respectively and further Breslau discloses that the temporal data reference profile traces accesses of object fields, and wherein the one or more hot data streams are for object field accesses. (Col 3:0037-0038, "...Access to the object...")

With respect to claim 4, the rejection of claim 1 is incorporated and further Breslau discloses that the coallocation solution includes one or more of field reordering, (Col 5:0051-0054, "...the identification, tracking, and instantiation...")object splitting, and object merging. (Col 3:0035-0037, "...merged status...to a split status...")

With respect to claim 5, the rejection of claim 1 is incorporated and further Breslau discloses further comprising: altering a computer program to implement the coallocation solution. (Col 3:0035-0037, "...merged status...to a split status...")

With respect to claim 6, the rejection of claim 5 is incorporated and further Breslau discloses that the altering comprises binary rewriting of a computer program. (Col 4:0041-0044, "...removal of the object from memory...")

With respect to claim 7, the rejection of claim 5 is incorporated and further Breslau discloses that the altering comprises rewriting of part of source code of the computer program under control of a programmer. (Col 4:0041-0044, "...removal of the object from memory...")

With respect to claim 8, the rejection of claim 5 is incorporated and further Breslau discloses that the altering comprises adjusting executable code for the computer program at compile time. (Col 5:0055-0056, "...is performed at run time...")

With respect to claim 9, the rejection of claim 5 is incorporated and further Breslau discloses further comprising: after the altering, executing the computer program, wherein run time support software enforces the coallocation solution. (Col 3:0036-0038, "...and accordingly generates a "split" request therefor...")

With respect to claim 10, the rejection of claim 1 is incorporated and further Breslau discloses a computer-readable medium storing the computer program altered according to the method of claim 5. (e.g See Fig. 1 and related text)

With respect to claim 11, the rejection of claim 1 is incorporated and further Breslau discloses that the coallocation solution is based at least in part on results of weighted set packing analysis for plural coallocation sets. (Col 3:0036-0038, "...and accordingly

generates a "split" request therefor...")

With respect to claim 12, the rejection of claim 11 is incorporated and further Breslau discloses that each of the plural coallocation sets comprises a set of allocation sites for objects in one of the hot data streams. (Col 4:0039-0041, "...object routing information contained within the ORB...")

With respect to claim 13, the rejection of claim 11 is incorporated and further Breslau discloses that each of the plural coallocation sets comprises a set of allocation sites for object fields in one of the hot data streams. (Col 4:0039-0041, "...object routing information contained within the ORB...")

With respect to claim 14, the rejection of claim 1 is incorporated and further Breslau discloses that the analyzing comprises: computing a heat value for each of the one or more hot data streams; and computing a weight value for each of the one or more hot data streams. (Col 3:0032-0035, "...the single instance, object B is split...", Col 5:0053-0055, "...an object that has a split status...")

With respect to claim 15, the rejection of claim 14 is incorporated and further Breslau discloses that the analyzing further comprises: avoiding double counting for sub-sets among the one or more hot data streams. (Col 4:0041-0044, "...removal of the object from memory...")

With respect to claim 16, the rejection of claim 1 is incorporated and further Breslau discloses a computer-readable medium storing computer-executable instructions for causing a computer system programmed thereby to perform the method of claim 1. (Col 2:0016-0017, "...operates in an object-oriented computer system...")

With respect to claim 19, the rejection of claim 17 is incorporated and further Breslau discloses that the method further comprises: detecting one or more hot data streams in the profile. (Col 3:0036, "...a performance monitor may detect...")

With respect to claim 20, the rejection of claim 17 is incorporated and further Breslau discloses that the coallocation solution includes object restructuring in a computer program, the method further comprising: executing the computer program after the object restructuring, wherein the coallocation solution guides object-level allocations in heap memory. (Col 4:0049-0051, "...Each entry in the table...")

With respect to claim 21, the rejection of claim 20 is incorporated and further Breslau discloses that the object restructuring includes field reordering. (Col 5:0051-0054, "...object B are facilitated...")

With respect to claim 22, the rejection of claim 20 is incorporated and further Breslau discloses that the object restructuring includes object splitting. (Col 1:0035-0038,

“...from a merged status...to a split status...”)

With respect to claim 23, the rejection of claim 20 is incorporated and further Breslau discloses that the object restructuring includes object merging. (Col 4:0046-0049, “...object being merged...”)

With respect to claim 24, the rejection of claim 17 is incorporated and further Breslau discloses that the coallocation solution includes object restructuring in a computer program, the method further comprising: performing the object restructuring at design time. (Col 4:0041-0044, “...object...execution environment...”)

With respect to claim 25, the rejection of claim 24 is incorporated and further Breslau discloses a computer-readable medium storing the computer program altered according to the method of claim 24. (Col 2:0028-0031, “...computer usable media...”)

With respect to claim 26, the rejection of claim 17 is incorporated and further Breslau discloses that the coallocation solution includes object restructuring in a computer program, the method further comprising: performing the object restructuring at run time. (Col 4:0041-0045, “...removal of the object...execution environment...”)

With respect to claim 27, the rejection of claim 17 is incorporated and further Breslau discloses that the method further comprises: executing a computer program, wherein

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the coallocation solution guides field-level allocations in heap memory. (Col 3:0035-0037, "...merged status...to a split status...")

With respect to claim 28, the rejection of claim 17 is incorporated and further Breslau discloses that the determining comprises: computing a weighted set packing for one or more field coallocation sets; and selecting the coallocation solution. (Col 3:0032-0035, "...the single instance, object B is split...", Col 5:0053-0055, "...an object that has a split status...")

With respect to claim 32, the rejection of claim 29 is incorporated and further Breslau discloses that the coallocation solution includes field reordering. (Col 5:0051-0054, "...object B are facilitated...")

With respect to claim 33, the rejection of claim 29 is incorporated and further Breslau discloses that the coallocation solution includes object splitting. (Col 5:0052-0055, "...an object that has a split status,...")

With respect to claim 34, the rejection of claim 29 is incorporated and further Breslau discloses that the coallocation solution includes object merging. (Col 4:0039-0042, "...merged"...")

With respect to claim 35, the rejection of claim 29 is incorporated and further Breslau

discloses that the coallocation solution is for guiding memory placement decisions for heap objects in subsequent execution of the computer program. (Col 3:0037-0038, "...Access to the object...")

With respect to claim 36, the rejection of claim 29 is incorporated and further Breslau discloses that the method further comprises altering the computer program to implement the coallocation solution. (Col 3:0035-0037, "...merged status...to a split status...")

With respect to claim 37, the rejection of claim 36 is incorporated and further Breslau discloses that the altering comprises binary rewriting of the computer program. (Col 4:0041-0044, "...removal of the object from memory...")

With respect to claim 38, the rejection of claim 36 is incorporated and further Breslau discloses that the altering comprises rewriting of part of source code of the computer program under control of a programmer. (Col 4:0041-0044, "...removal of the object from memory...")

With respect to claim 39, the rejection of claim 36 is incorporated and further Breslau discloses that the altering comprises adjusting executable code for the computer program at compile time. (Col 4:0041-0045, "...removal of the object...execution environment...")

With respect to claim 40, the rejection of claim 36 is incorporated and further Breslau discloses that the method further comprises: after the altering, executing the computer program, wherein run time support software enforces the coallocation solution. (Col 3:0036-0038, "...and accordingly generates a "split" request therefor...")

With respect to claim 41, the rejection of claim 36 is incorporated and further Breslau discloses a computer-readable medium storing the computer program altered according to the method of claim 36. (Col 4:0043-0046, "...another program or object executing...")

With respect to claim 42, the rejection of claim 29 is incorporated and further Breslau discloses that the temporal data access profile includes a series of data accesses spanning execution of the computer program during a profiling run. (Col 4:0040-0044, "...Regarding object access,...")

With respect to claim 43, the rejection of claim 29 is incorporated and further Breslau discloses that the coallocation solution is for guiding memory placement decisions for heap objects in subsequent execution of the computer program, (Col 4:0049-0051, "...ORB Routing Table tracks objects...") the method further comprising:

coallocating a first set of heap objects in a first heap memory arena to improve locality for accesses of the first set of heap objects; (Col 4:0050-0051, "...is represented in the ORB Routing table...")

coallocating a second set of heap objects in a second heap memory arena to improve locality for accesses of the second set of heap objects; (Col 5:0051-0054, "...the object identifier...is associated with a SIP corresponding...")

and allocating other heap objects in a default heap memory arena. (Col 5:0051-0054, "...the object identifier...is associated with a SIP corresponding...")

Response to Arguments

8. Applicant's arguments with respect to claims 1-43 have been considered but are moot in view of the new ground(s) of rejection.

Applicant's arguments filed 05/11/07 regarding claims 44-52 have been fully considered but they are not persuasive. Following is the Examiner's response.

With respect to claim 44, Applicant essentially argues that Breslau (U.S. Pub 2002/0133639) does not teach or disclose an allocation or a coallocation solution.

In response, the Examiner disagrees, Notes Col 3:0036-0037, it is here that Breslau discloses that a split request may be generated by a performance monitoring program that has determined an overload condition for a merged object within an execution environment. He also mentions that a performance monitor may detect that a single

instance, say object b is overloaded on host 37, the monitor will generate a split request as a result. Thus, Breslau does disclose an allocation or a coallocation solution.

Conclusion

9. THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mark P. Francis whose telephone number is (571)272-7956. The examiner can normally be reached on Mon-Fri 8:00-4:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Meng-Ai T.An can be reached on (571)272-3756. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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